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AMANITAS FROM KING'S PARK, PERTH

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The genus *Amanita* Persoon ex S. F. Gray includes some of the best known and most conspicuous gilled fungi. It includes some good edible species as well as the only deadly ones, for which no antidote is known. It is characterized by a double veil, i.e. an outer (general) veil which encloses the whole specimen in its very young stage, and an inner (partial) veil which encloses the gills and the lower face of the cap. Remnants of the outer veil may persist as a volva (cup) at the foot of the stem and as warts on the cap. Remnants of the inner veil may be found as a ring around the upper part of the stem. In the older classifications ringless species were placed in a separate genus *Amanitopsis*, but this genus has now been discarded because it was found that both ringed and ringless individuals could occur within the same species. In all *Amanitas* the spores are white or nearly white in mass, hyaline (translucent) when viewed singly. In many species the spores turn purplish-bluish when stained with an iodine reagent.*

It is quite possible that South-western Australia may have been a secondary centre of evolution and dispersal for the *Amanitas*. The writer has record of 10 to 15 different forms from South-western Australia, some of them certainly new, and since collecting has mainly been done within a few miles from Perth and during a few years only, there is good reason to believe that more species may be found in the future.

By combining the lists given by Cooke (1892), McAlpine (1895), Cleland (1934), Willis (1950 and *in litt.*) and Aberdeen (*in litt.*) one finds records of 14 species of *Amanita* (including *Amanitopsis*) for South Australia, 13 for Victoria (of which Willis questions 3), 5 for New South Wales, 6 for Queensland, and 3 for Tasmania. These figures mean very little, because the intensity of mycological collecting and the publication of data vary considerably from State to State. However, it is not unreasonable to assume that there is a decrease in the number of species from west to east. This is even more so if one omits from the South Australian and the Victorian lists the typically European red-capped form of *A. muscaria*,

* Melzer's reagent as described by Singer (1949) has been used on our specimens.

found under European trees, and from the South Australian list the Northern Hemisphere's *A. rubescens*, found under chestnut trees on Mount Lofty. These are obviously introduced mycorrhizal species, which do not belong to the original Australian flora, and which might also be found in the remaining States at some future time.

The forms described in this paper have all been collected in King's Park, but some of them are quite widespread, as is shown by the list of localities given in each case.

Taken as a group, these Australian Amanitas present an aspect notably different from that of any corresponding group in the Northern Hemisphere. White is dominant. Caps are very often bare. Stems often lack ring and volva, or only vestigial flakes are present.

All species are infested by hundreds of spore-feeding Collembola (Spring-tails, *Hypogastrura* sp.) to a degree not even remotely approached by other fungi. Cleland (1934) mentions *H. armata* as having been found once on "a small toadstool" in New South Wales, but there is no explicit mention of any Collembola found on Australian Amanitas. Why the spores of Amanitas should appeal so much more than those of any other gilled fungus is not known. These insects may also act as spore-carriers. Fly maggots on the other hand are not common in the caps of Amanitas—if they are found at all, they prefer the fleshy base of the stem—whereas they are very plentiful in the thick caps of several species of *Boletus*.

All species have in common a peculiar smell which gradually develops in the process of decay. Slow drying brings forth a strong smell as of sweet flour, but if moisture is not thoroughly removed a nauseous yet sweetish characteristic smell soon develops, probably due to some peculiar fermentation—a decaying Amanita can be recognized even when unseen, from a few yards away.

No tests for edibility have been made. There is record of a double case of poisoning from *Amanita preissii* (see below), and on the other hand European practice shows that *A. spissa* is edible. However, with a genus like *Amanita* experiments are out of the question.

Amanita preissii Fries

About 1839 Preiss collected an Amanita in South-western Australia, presumably near Perth. The description was given by Fries (1846) and a translation of the Latin original would read as follows:—

Agaricus (Amanita) Preissii Fr., cap fleshy, convex-expanded, sticky, edge even; stem stuffed, mealy, pallid, rooting with turnip-shaped volva narrowed at the tip, with a free persistent edge, ring placed high on the stem and pendulous, gills adnate, crowded. In sandy places in forests, May. Preiss's Herb., No. 2665.

A very noble species, clearly distinguished from all other known species by the nature of the volva. The size is that of *A. porphyrius* but the species should rather be compared with *A. ovoideus* and *A. solitarius*.

Why Cooke (1892) should translate Fries's *arenosis umbrosis sylvarum* into a rather misleading "sandy soil, woods, etc." and why he should omit Fries's concluding remarks will never be known. Dennis (1953, *in litt.*) states that to the best of his knowledge "no figure exists or was published of *Ag. preissii* Fr. and it is most unlikely that any material of it still exists." This is why the remarks on the characteristic shape of the volva are so important.

Cleland (1943) relates a case of poisoning after the ingestion of fungi which were identified as *Amanita preissii* by the Government Botanist of the time (1921). Since the species is only found in forests, and the two victims lived in Subiaco, it is likely that the fungi were actually collected in King's Park, the nearest forest.

The symptoms of the poisoning were already apparent *half an hour* after the meal, and consisted of watering at the mouth with nausea, and half an hour later colic, collapse, *profuse sweating*, *cold clammy skin*, and *very slow pulse*. Injections of atropine sulphate and a strong emetic brought both victims back to normal within a few hours. Dr. W. H. Nelson, who treated them, correctly diagnosed the symptoms as those of muscarin poisoning. According to Maublanc (1946) the toxicity of the Amanitas so far studied in the Northern Hemisphere is never due to muscarin, which even in *A. muscaria*, where it was first discovered, occurs in negligible quantity; *A. preissii* may be unique in having such a high muscarin content as to be toxic.

The most common *Amanita* of King's Park (Fig. 1) could be described in the following terms:—

Cap 2-3 em. in diameter when at the button stage, almost hemispherical (1a), gradually expanding to 5-8 em., convexo-expanded (1e) and finally slightly depressed at the centre when adult (1g), slightly viscid in wet weather, usually smooth (1g), but at times with irregular flat warts which are hardly noticeable (1h), especially when the cap is loaded with soil (as is nearly always the case), colour white with a faint bluish tinge towards the centre, the white always rather cream or ivory like, never chalky. A specimen with a pale salmon-coloured cap probably belongs to this species. The cap is of medium thickness, always definitely fleshy (1g).

Gills adnate to adnexed, moderately crowded, straight at first (1h) then ventricose (1g), white at first, tending to a creamy colour later on.

Stem 8-12 em. high from its junction with the cap to its lower end. Over a length of 5 to 8 cm. from the top the stem is subcylindrical, tapering slightly upwards, with a diameter of 8 to 18 mm. at the top and 8 to 24 mm. at the bottom of the subcylindrical portion (stem proper). Below this is the bulbous portion, more or less turnip-shaped, nearly always with pointed apex, 3-5 cm. high and with a maximum diameter of 22 to 43 mm., usually located between the upper third and the upper half. The surface of the stem is always more or less mealy. Two specimens had rust-coloured marks on the stem.

Ring superior, membranous (1h) to friable (1g), at times with faint striations left by the gills on its upper face (1h), often evanescent. A specimen had the ring stained burnt sienna, apparently not from the soil, which was much paler.

Volva as a distinct upper edge to the bulbous portion of the stem, initially as a free membranous border which in one specimen extended up to 11 mm. upwards but was already torn (1h). In a few specimens the volva extends only for 2 to 5 mm. upwards (1j), and in many specimens no volva is visible even in the young stage (1a,c). If the stem is sectioned

the place where the volva has been is usually marked by a sharp edge (1d). The volva is always membranous.

Spores (1i) broadly elliptical, at times subovate or subspherical (in a young specimen distinctly cylindrical), some of them obliquely apiculate, hyaline singly, white in mass, turning bluish-grey when stained with an iodine reagent.

Similar specimens have been found in April at Scarborough, in June at Churchman's Brook, Kelmscott, Wungong and Merredin, and in July at Chittering Brook and Bickley.

Drawings of *A. preissii* and its *levis* form (see below) have been submitted to Willis for comparison with Victorian species, and it is confirmed that neither has been found in Victoria so far, and that they differ from the nearest Victorian species, *A. farinacea*.

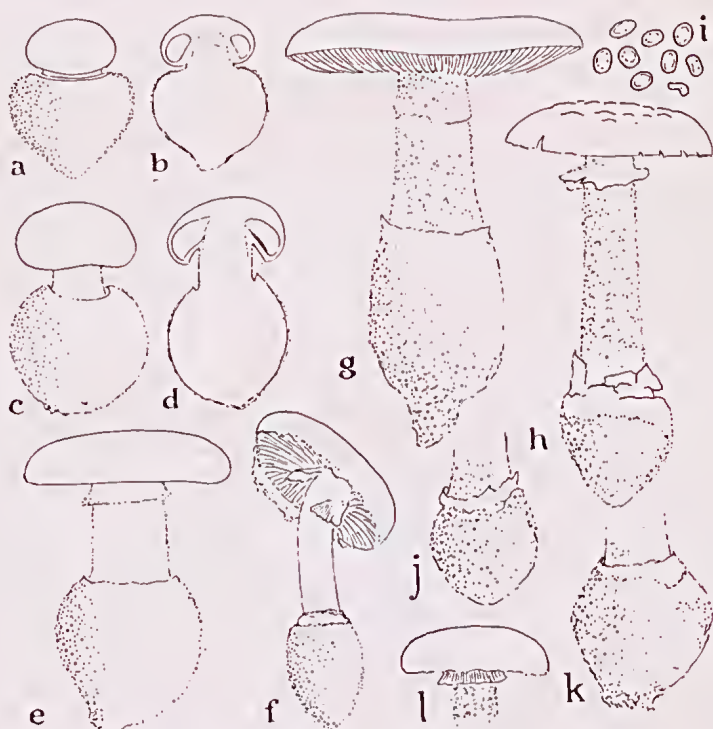


Fig 1.—*Amanita preissii* Fries.

(a) Very young specimen and (b) section of same. (c) Young specimen with cap well raised and distinct volval rim. (d) Section of same showing thickness of partial veil below the gills, and volval rim. (e) Young specimen with veil. (f) Young specimen with torn ring and cortina remnants. (g) Adult specimen with evanescent ring. (h) Adult specimen with unusually large ring and volval remnants, and warts on cap. (i) Spores, x 300. (j) and (k) Typical rooting portions of stems showing volval remnants. (l) Young specimen showing shape of cap, striated ring, and mcaliness of stem.

—Illustrations half natural size throughout, excepting those of spores.

Amanita preissii Fr. forma *levis* nov.

A number of specimens found in King's Park (Fig. 2) could be described as follows:—

Cap 2.5 to 7 cm. in diameter, plano-convex to plane (2 c-c) with a slightly depressed centre when fully developed (2 d-g). damp but not quite viscid in wet weather, usually smooth, rarely with hardly noticeable whitish warts, white, at times with a faint biscuit or brownish tinge towards the centre. One specimen was coffee brown. The flesh is relatively thin (2 c,h).

Gills adnexed to free (2h), moderately crowded (2e,f), soon ventricose (2h), white, perhaps tending to a yellowish cream colour when old.

Stem 6 to 11 cm. high from its junction with the cap to its lower end. Over a length of 5 to 9 cm. from the top the stem is cylindrical or very slightly tapering upwards, with a diameter of 4 to 10 mm. near the top and 5 to 10 mm. at the bottom of the stem proper. Below this is the bulbous portion, olive or cherry shaped, usually rounded below, 10 to 25 mm. high

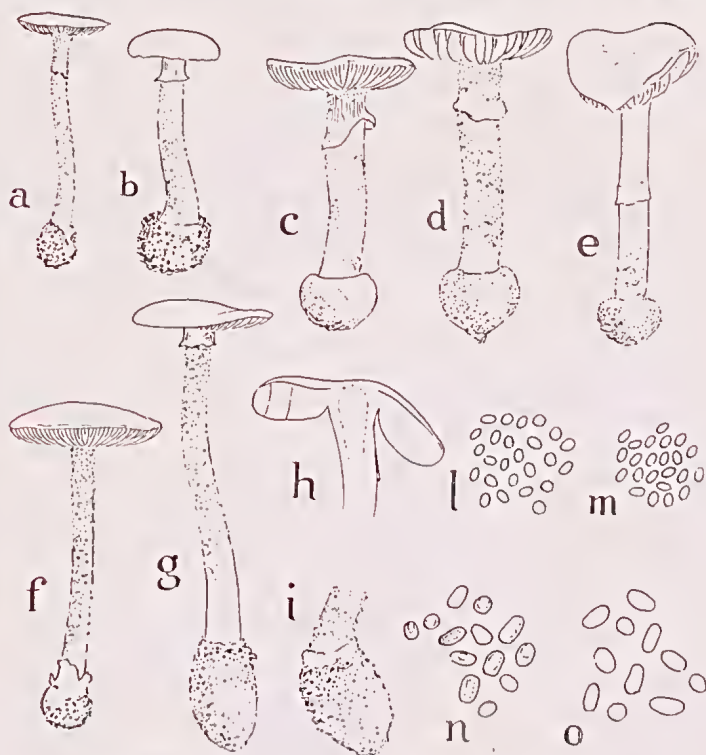


Fig. 2.—*Amanita preissii* Fr. forma *levis*.

(a) Small mature specimen with evanescent ring. (b) Young specimen with well developed ring and evanescent volva. (c), (d), (e) Specimen probably from same mycelium but of different age—notice differences in ring and meallness of stem. (f) Mature specimen with no ring and exceptionally well developed volval remnants. (g) Mature specimen, exceptionally tall, with membranous ring and olive-shaped rooting portion. (h) Section of cap of old specimen showing normal and rudimentary gills, and junction of tissues at centre of cap. (i) Rooting portion of same, showing distinct volval rim and meallness of stem. (l) and (m) Spores, x 150. (n) and (o) Spores, x 300.

and with a maximum diameter of 10 to 20 mm., usually located near the middle or the upper third. The surface of the stem is mealy, but the mealiness varies considerably (2e,f).

Ring superior (2b-d), sometimes median (2e), membranous (2b,d) to friable (2a,b), at times with faint striations on the upper face (2b,c) at times evanescent (2f).

Volva, membranous as a distinct upper edge to the bulbous portion of the stem (2g,i). In one specimen as shreds up to 6 mm. high (2f), often lacking except as a sharp edge (2b-e).

Spores elliptical to subspherical (2l-o) some quite spherical, with no noticeable apiculate, hyaline singly, white in mass, turning bluish-grey when stained with iodine reagent.

It is possible that this may only be a form of *A. preissii* living in mycorrhiza with *Banksia* or *Casuarina* and differing from the type in the characters printed in black above, whereas the typical *A. preissii* has usually been found not far from *Eucalyptus* trees. On the other hand the undergrowth consists of many shrubs, which could support mycorrhizal growth. The specimens described above have nearly all been found in the vicinity of *Banksia* or *Casuarina* trees, and in some instances there were no *Eucalyptus* trees nearby.

Amanita preissii Fr. forma *ochroterrea* nov.

Two specimens collected at an interval of two weeks in different parts of the Park were outstanding in size (Fig. 3), and with a distinctly earthy-buff cap. The colour was also noticeable on the stem. Most strikingly, the spores of the darker specimen also showed a distinct buff tinge.

Cap 10-11 cm. in diameter, matt, earthy buff in colour, becoming darker with age. In one specimen with rough patches which might be termed depressed angular warts, and were especially noticeable near the centre of the cap (3c).

Gills as in the typical form but earthy buff in colour, becoming dark buff in time.

Stem 16 to 19 cm. high, subcylindrical attenuated (20 to 28 mm.) just above the middle, 23 to 30 mm. thick at both ends of the stem-proper portion (which is 10 to 13 cm. long) and 42 to 55 mm. thick in the upper quarter of the bulbous portion, which is about 7 cm. high and turnip-shaped. Exposed part mealy.

Ring superior, evanescent, just noticeable in one specimen (3c) and absent from the other (3a).

Volva only noticeable as the upper rim of the bulbous portion of the stem.

Spores subcylindrical, very elongate (3b,d), not apiculate, hyaline singly, very pale buff in mass, turning bluish-grey when stained with an iodine reagent.

This species or variety differs from typical *A. preissii* because of its colour, its size, and the shape and colour of the spores, and from *A. ochrophylla* Cke. et Mass. in the more earthy colour of the gills, the coloured spores, the evanescent ring, and the shape of the bulbous portion.

General remarks on the *Amanita preissii* complex

A few specimens show characteristics which are intermediate between those of the forms described above. A specimen has cap and stem proper of *A. preissii* and bulbous portion of *A. preissii*

forma *levis*, except for the size. Another specimen has cap and stem proper of *A. preissii* forma *levis* at least as far as size goes, and bulbous portion of a typical *A. preissii*. It seems reasonable to suggest that all these may be mere forms due to variations in the environment, possibly in the host plant. *A. preissii* forma *ochroterrea* however has spores which are quite distinctive in shape and colour.

Are we dealing with species, varieties, or just forms? What is a valid criterion for the distinction of fungal species? Certainly not the individual peculiarities which so delighted the early taxonomists.

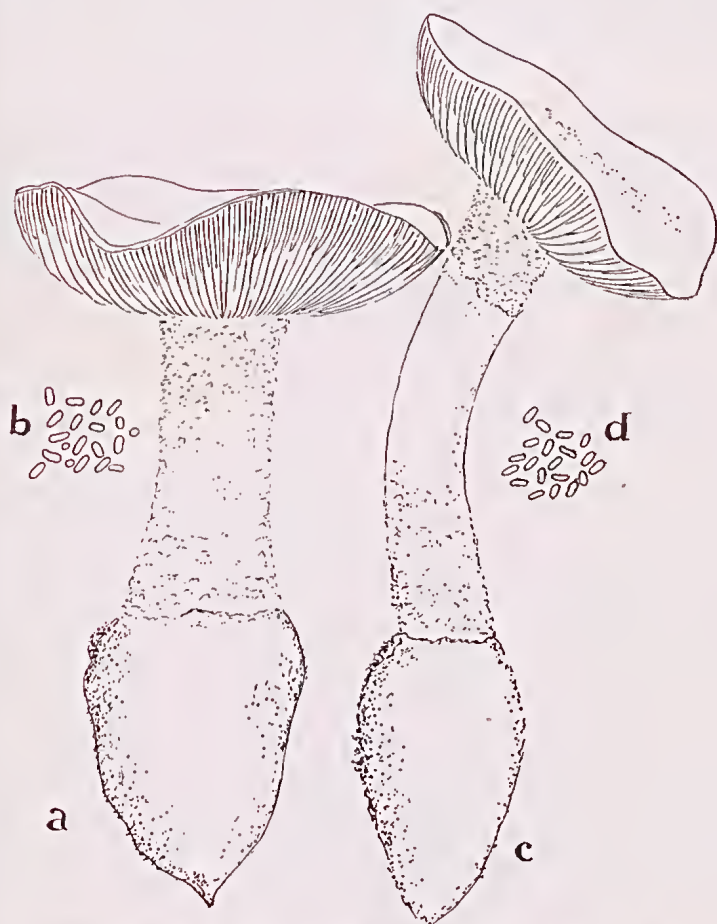


Fig. 3.—*Amanita preissii* Fr. forma *ochroterrea*.

(a) Fully grown specimen which was earthy-buff in colour when collected, and grew darker while drying. Notice mealiness of stem, absence of ring, and shape of rooting portion. (b) Spores of same, x 150. (c) Mature specimen which was tinged with earthy-buff on the cap, showing remnants of evanescent ring, shape of rooting portion of stem, and small warts on cap. (d) Spores of same, x 150.

Amanita conico-bulbosa Clel.

Specimens from King's Park (Fig. 4) are as follows:—

Cap 35 to 65 mm. in diameter, depresso-hemispherical at first (4a), then plano-convex (4c,g) and finally with edge slightly raised (4d), moist but not quite viscid in rainy weather, often smooth (4c) at times with irregular raised warts (4d,f,g) (often hidden by the soil that covers the cap), chalky white, at times with tinges of grey near the centre. The flesh is of medium thickness (4e).

Gills adnexed (4c), free later on, slightly ventriose, crowded (4d), white, tending to pale straw yellow or cream colour later on.

Stem 10 to 17 cm. high from the lower end, cylindrical tapering upwards for a length of 5 to 9 cm. from the junction with the cap (stem proper), and tapering downwards for 4 to 8 cm. (rooting portion). The

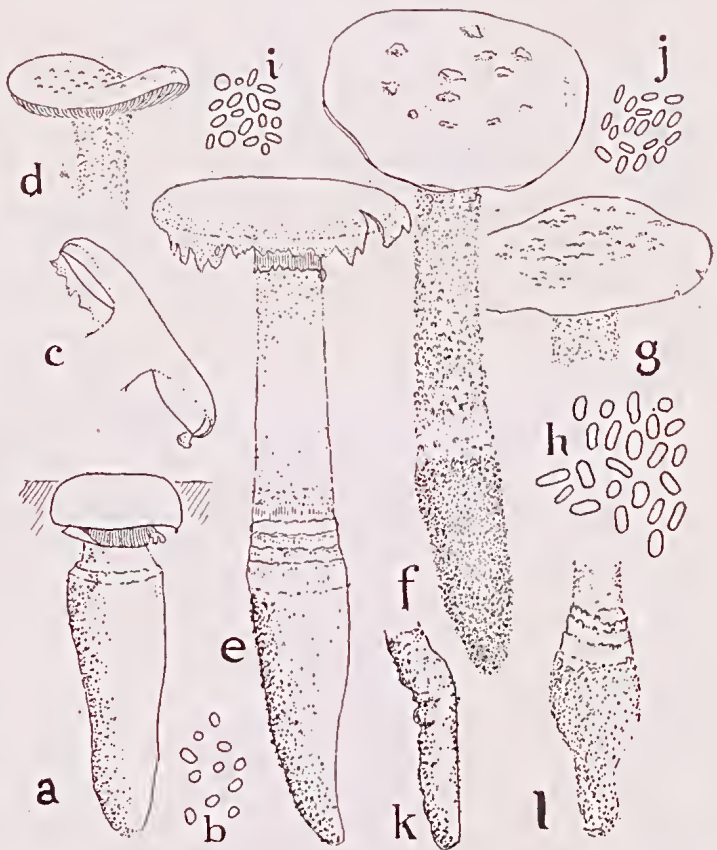


Fig. 4.—*Amanita conico-bulbosa* Clel.

(a) Very young specimen with whole ring, and (b) partly developed spores. (c) Section of mature specimen showing details of torn veil and ring. (d) Adult specimen with remnants of veil, striated ring, mealy stem, and volval remnants of ring at the foot of the stem proper. (e) Mature specimen with large warts and very mealy fibrillose stem. (f) Mature specimen with numerous small warts. (g) Mature specimen with numerous small warts. (h) Spores, x 300. (i, j) Spores, x 150. (k) and (l) Atypical rooting portions of stems.

stem proper varies in diameter from 7 to 13 mm. near the top to 10 to 19 mm. just above the beginning of the rooting portion, which varies in diameter from 10 to 25 mm. at the top and extends downwards, usually tapering off very gradually, in rare cases without tapering off until the rounded end is reached. Usually the lower end is almost pointed. The stem proper is always more or less mealy (4c.f), seldom mealy-scaly.

Ring superior striate (4e), evanescent and often lacking (4d,i,g), very friable even when well developed.

Volva friable, only noticeable as a series of two (4a), three or more (4c,b) rings or fibres around the top of the rooting portion. Usually there is no sharp edge to mark the transition from the stem proper to the rooting portion (4f), and even the change in diameter may be insignificant (4k). A section shows that the cortical tissues of the rooting portion are encrusted with soil particles in a characteristic way.

Spores subcylindrical to subelliptical (4h,i,j), definitely elongate but odd ones subovate, not apiculate, hyaline singly, white in mass, turning bluish-grey when stained with iodine reagent.

The description given above agrees with Cleland's (1934) description of the South Australian type, except that according to Cleland there may be a "biscuity tint" on the cap, and the spores are given as "elliptical, white, 9 to 11.5 x 5.5 to 7 μ ." Could Cleland have included specimens of *A. preissii* among his collections of *A. conico-bulbosa*? The shape of the spores, the nature of the volva, the shape of the rooting portion of the stem differentiate these species.

Besides being quite common in King's Park, *A. conico-bulbosa* has been found at Yanchep, Chittering Brook, Mundaring and Kelmseott. There is no record from the Eastern States, and Willis (*in litt.*) states that drawings of this species are unlike any Victorian species.

It is interesting to remark that the closest ally in the Northern Hemisphere is *A. solitaria* Bull., a species which is most variable and which in its extreme degree of wartiness has even been described as a separate species under the name of *A. strobiliformis* Vitt. This resemblance had already been noticed by Fries (1846). Atkinson (1901) gives photographs of 9 specimens of *A. solitaria* collected in North Carolina. These specimens resemble our specimens of *A. conico-bulbosa* very closely, but seem to have tougher veils, if one may judge from the rings and cortinas shown in the photographs.

Bresadola (1927) states that *A. solitaria* has a white cap with greyish centre, and is covered with flat angular grey warts; its edge is beset with white flaky-mealy shreds. The stem has large flaky-mealy scales which soon fall off, leaving a flaky surface. The rooting portion of the stem may be root-like with a distinct edge, or subovate, or globose. Ring and volva are evanescent. The illustration given shows two specimens which, if one ignores the deciduous warts and scales, resemble *A. conico-bulbosa* and *A. preissii* respectively.

On the other hand Maublanc (1946) states that the warts of *A. solitaria* are variable, being at times flat, angular, ashy grey, and at times truncated-pyramidal. The stem when young is covered with mealy scales which fall off. The base is swollen to form an ovoid bulb with some scales or some more or less definite concentric

knobs. The specimens illustrated have very little in common with those shown by Bresadola.

Singer (1949) accepts *A. strobiliformis* but omits *A. solitaria* from his list.

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(To be continued)

SEX RATIO AND VARIATION IN *APUS AUSTRALIENSIS* SPENCER AND HALL

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I. SEX RATIO

In the absence of comprehensive works on Australian natural history local field workers are forced to use overseas texts. Commonly used text-books all mention that the males of *Apus* are rare. Examples of such statements are as follows:—

"Males are rare, reproduction being normally by parthenogenesis" (Borradaile *et al.*, p. 362). "The large majority of individuals of *Lepidurus* and *Apus* are females, males are of comparatively rare occurrence" (Parker & Haswell, vol. 1., p. 395). "One species has been shown to be hermaphrodite; in others males are occasionally found, but reproduction appears to be, as a rule, parthenogenetic" (*ibid.*, p. 396).

The statements appear to relate to *Apus caneriformis* the common *Apus* of England and Europe but while these